Aerogel Read out Electronics

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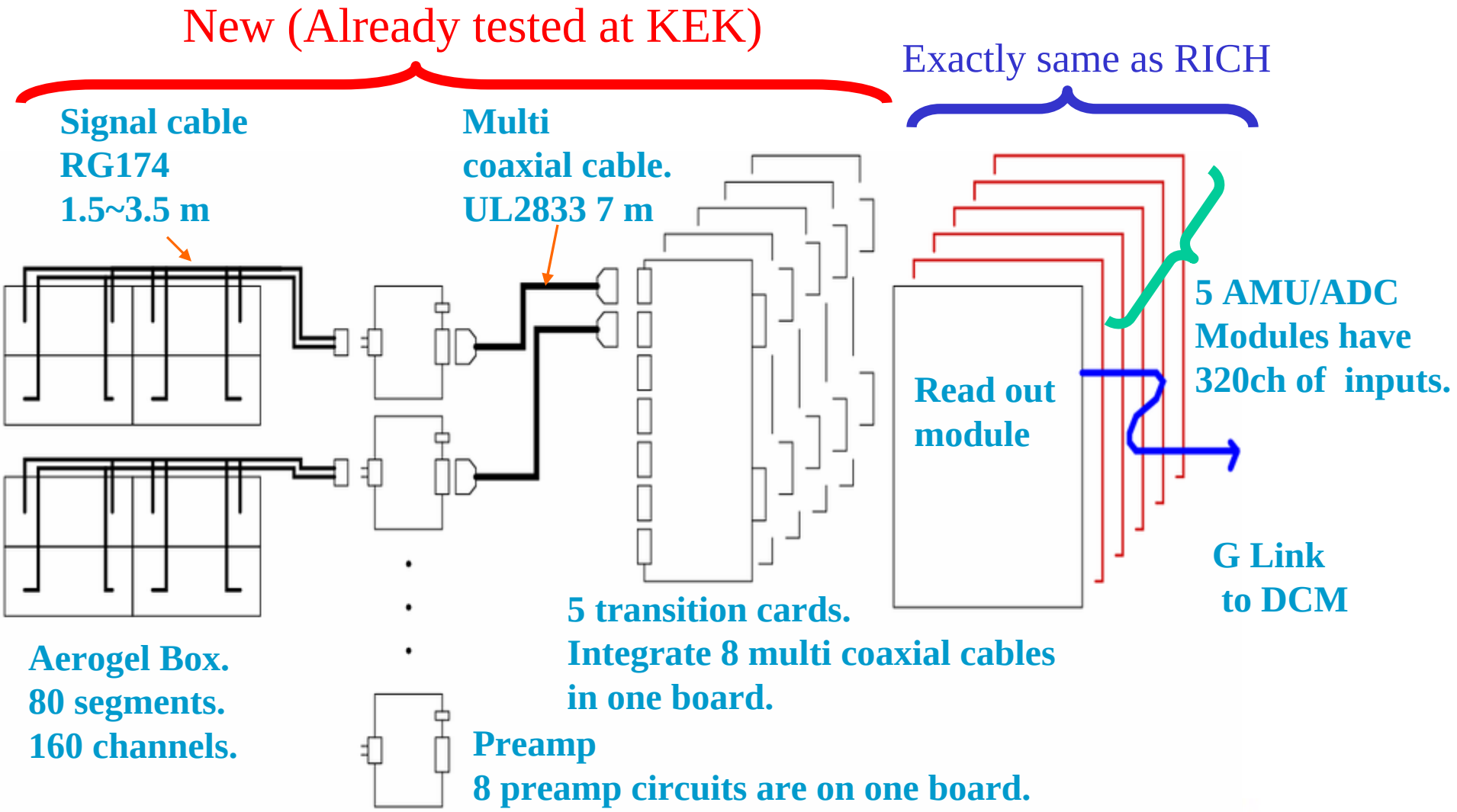
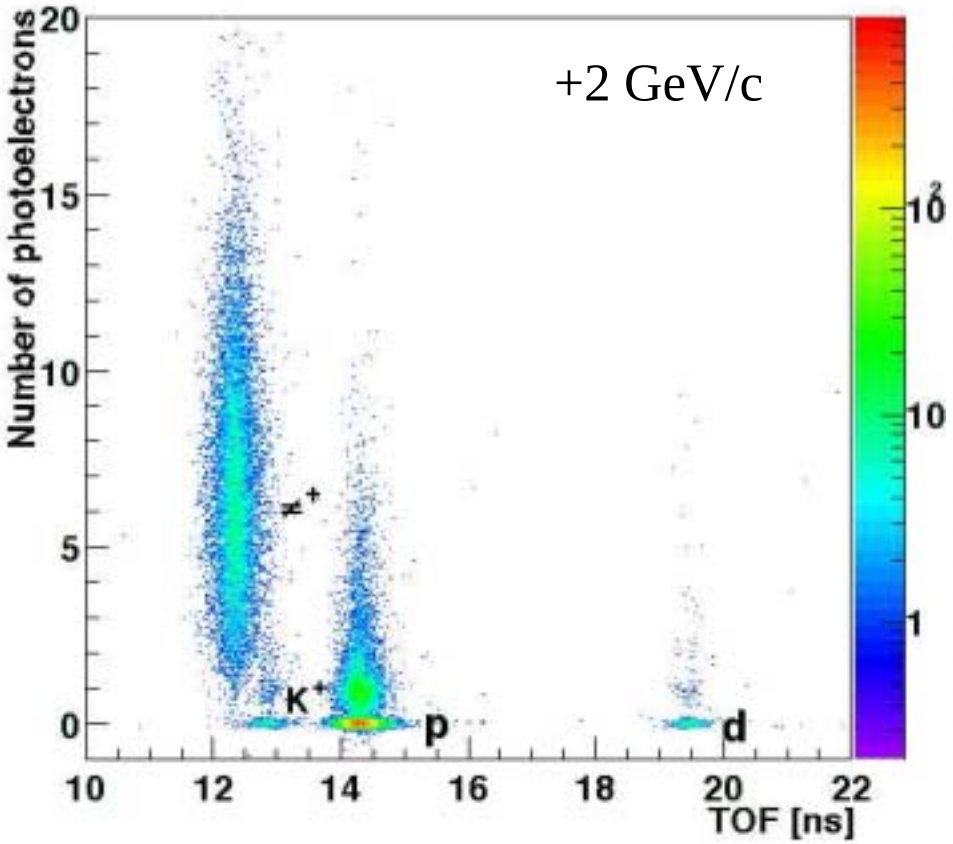
Concepts of readout electronics

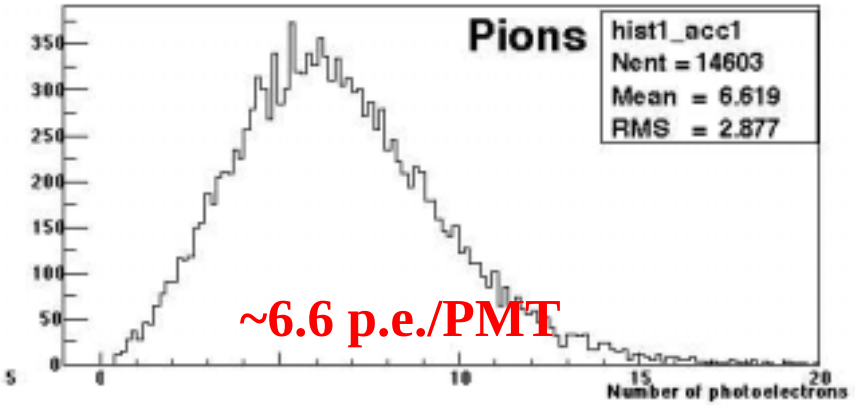
The electronics of the Aerogel detector is based on RICH's.

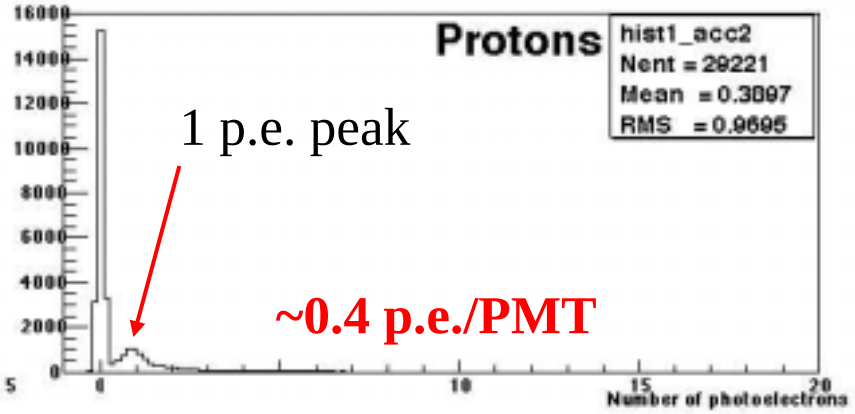


Observed Clean Signal

Final Prototype Test







- Very clean separation
  - Amount of photons other than Aerogel Chrenkov is small!

Preamp circuit

Op-amp

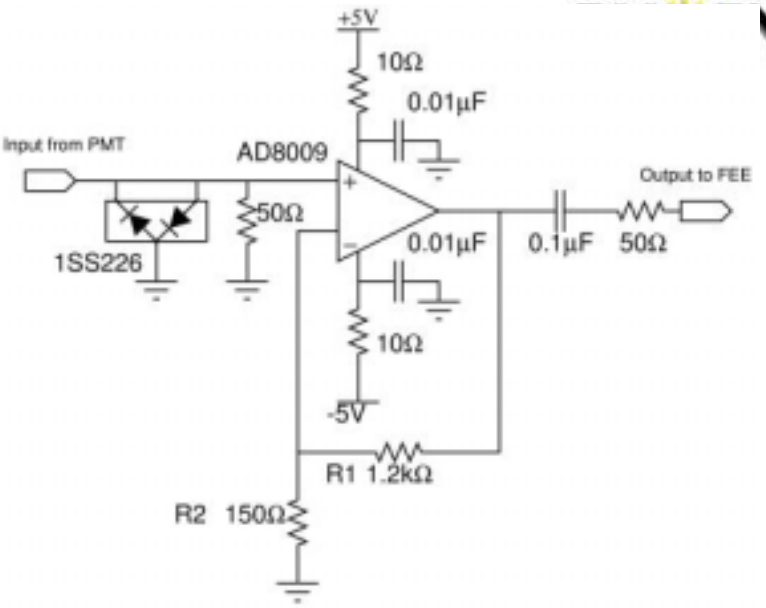
AD8009

slew rate: 5500uV/s

Bandwidth: 1GHz

Gain

x 4.5



The lowest gain at the 1500V

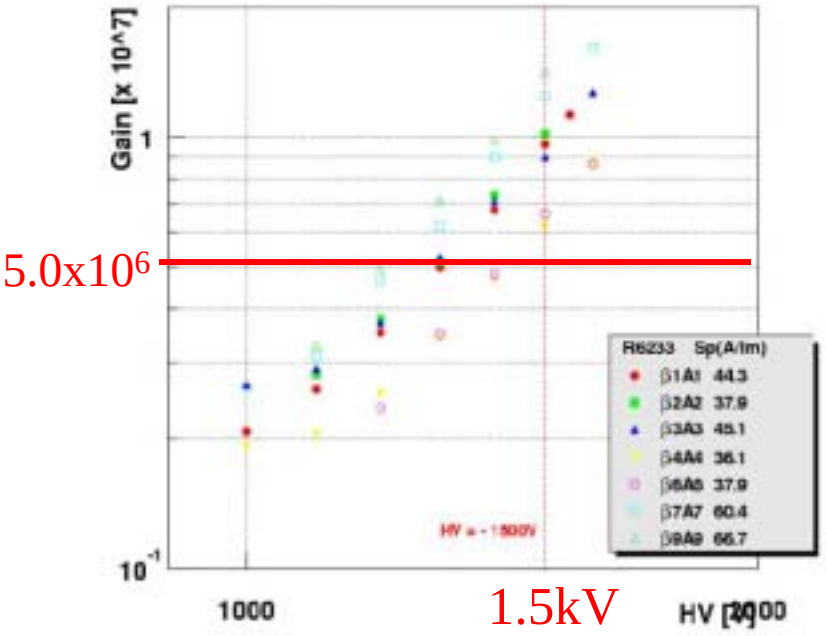
- PMT gain = 5.0×10^6
  Anode sensitivity at 30 (A/lm)
- Correspond to 0.8pC/p.e.

To measure the photo-electrons at the range from **0 to 50 p.e. (0 to 40pC)**

~x 4

FEE dynamic range **0 to 160 pC**

Required Preamp's net gain x 4



Preamp circuit (Gain check)

Gain test

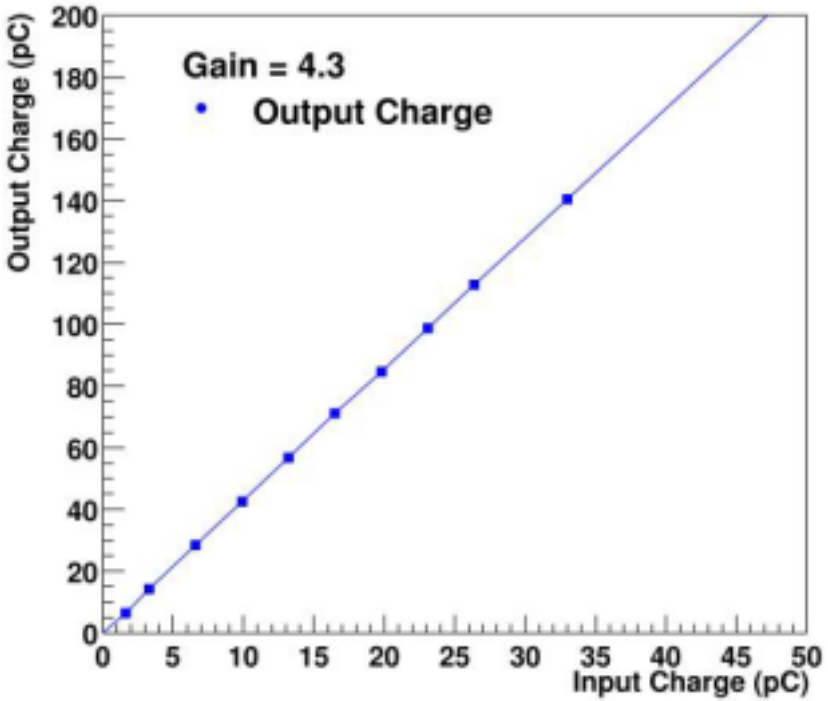
The gain of the circuit is measured using the real prototype.

The output charges is plotted as a function of input charges.

It clearly shows good linearity.

Actual gain is 4.3.

(Design value is 4.5.)



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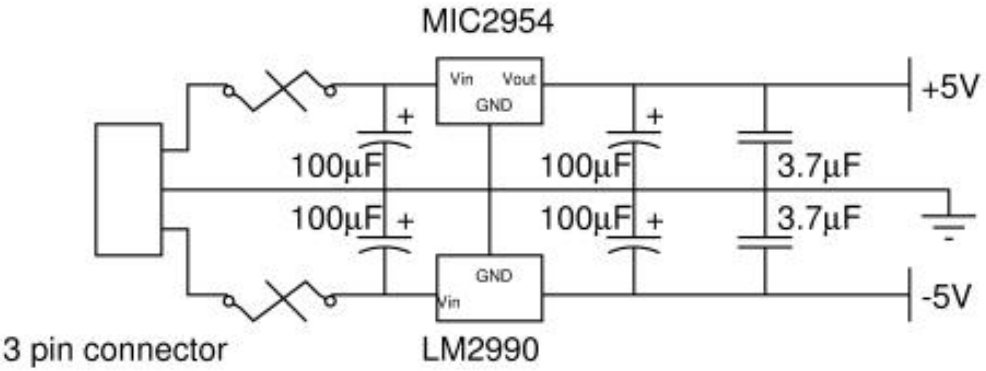
Preamp circuit (Regulator and Heat)

Regulator

MIC2954 +5V, minimum drop 0.5V
LM2990 - 5V, minimum drop 0.5V
Operation drop voltage will be 1.5V
(Input low voltage 6.5V)



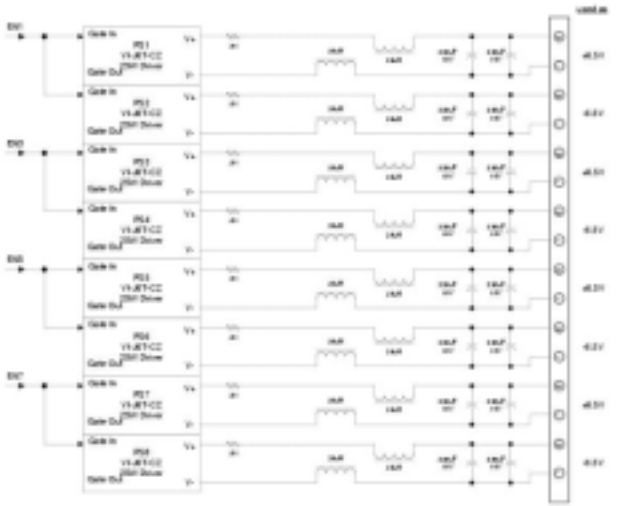
Heat issue

The measured current is 0.12A.
Thus, 0.12A x 6.5V x 2 (positive and negative) = 1.5W
1.5W x 20 preamp boxes = 30 W
All preamplifier cards are located in the open air and this heat can be removed by the ambient air

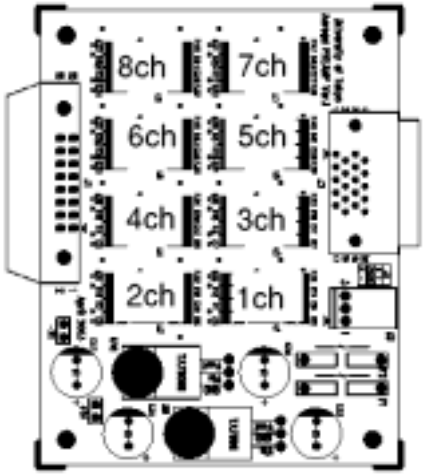
Each LV is fused.

Low voltage

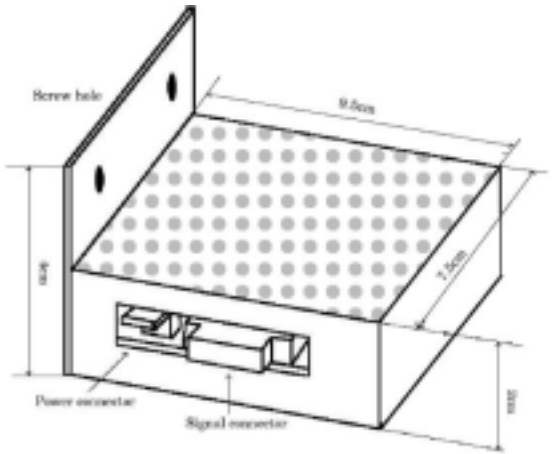
One LVLP module has 8 channels.
One LVLP channel can supply 25 W power.
On channel supply LV to 5 preamplifier cards.
Five cards uses 0.75W x 5 = 3.75 W per on kind of LV.
It is sufficient lower than the maximum power.
The cable and modules for low voltage are the same as the RICH one.



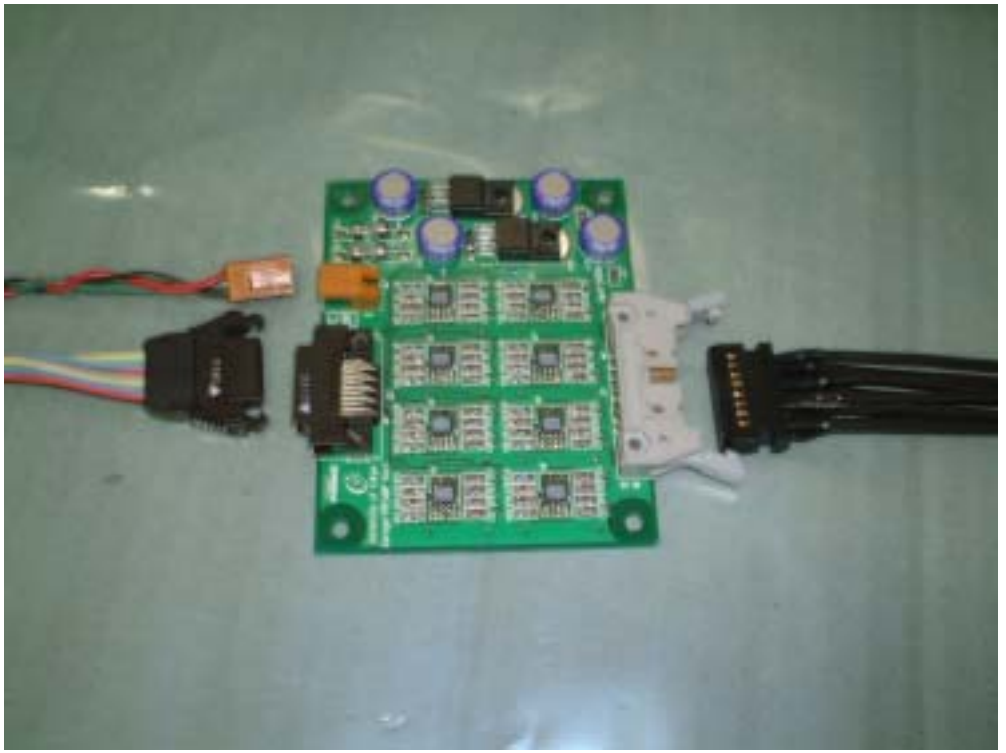
Mechanical design of preamplifier



Integration of the preamplifier card



Schematic view of the preamplifier box

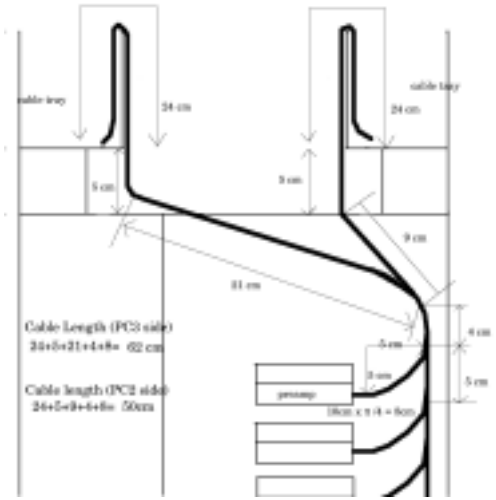


Concerns:

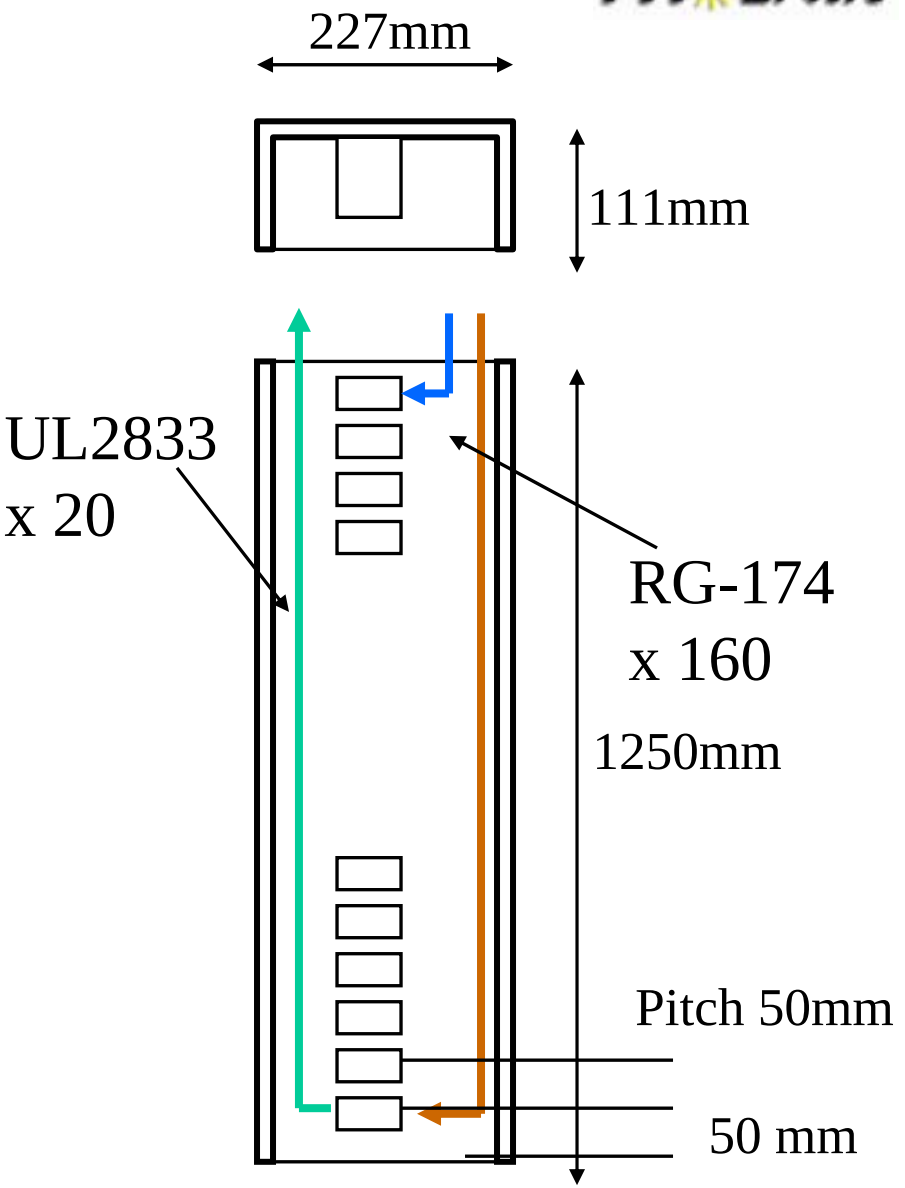
- Cooling issue
- holes on the plates or Heat sink?
- Fan?

Location of preamplifier

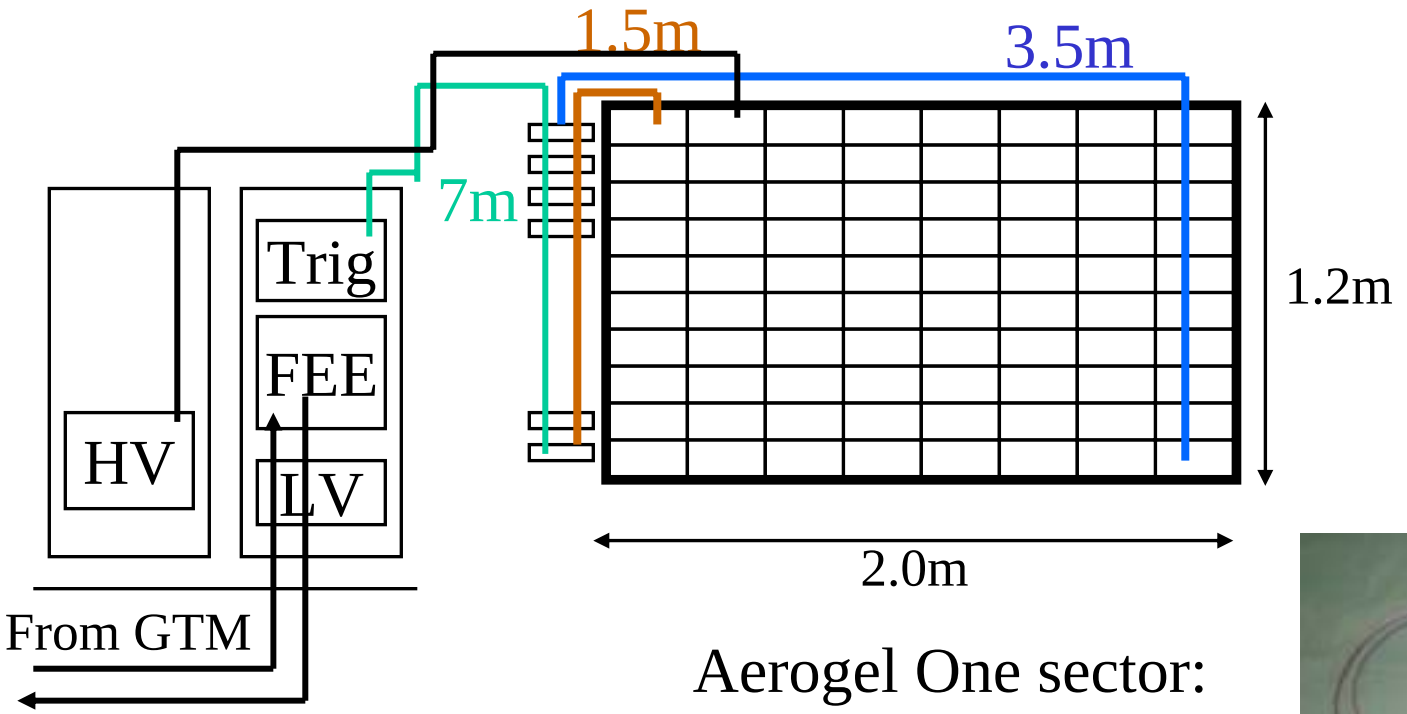
Top view



Side view



Concepts of cabling



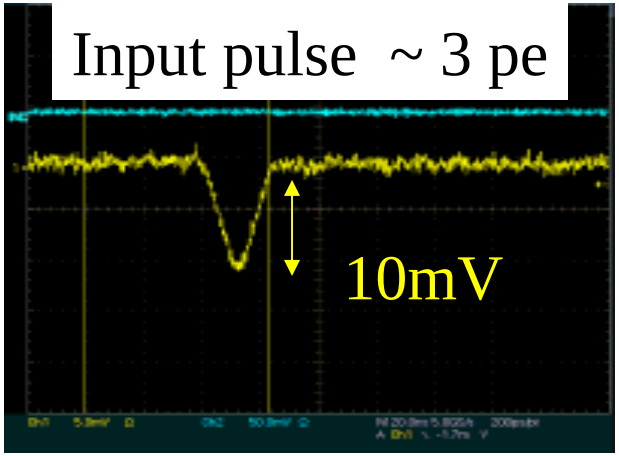
Aerogel One sector:
80 segments
160 channels

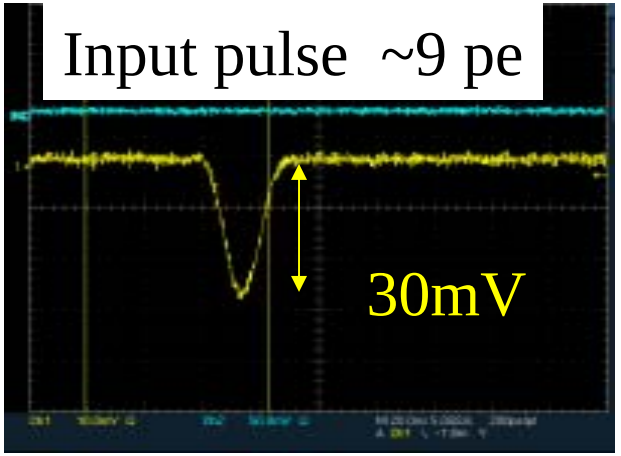
PMT to preamp cards RG-174/U	Preamp cards to FEE UL2833

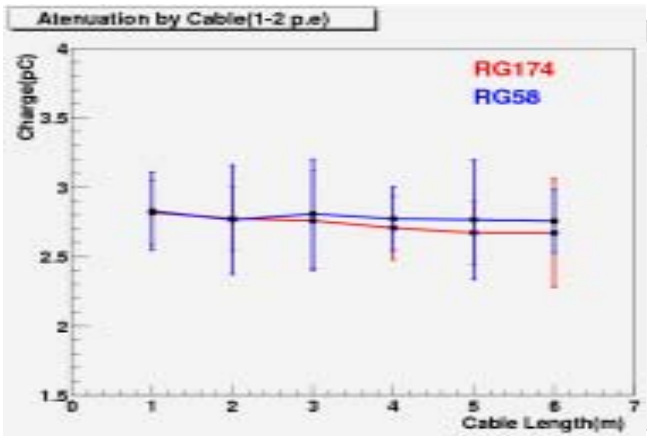
Cable From PMT to Preamp

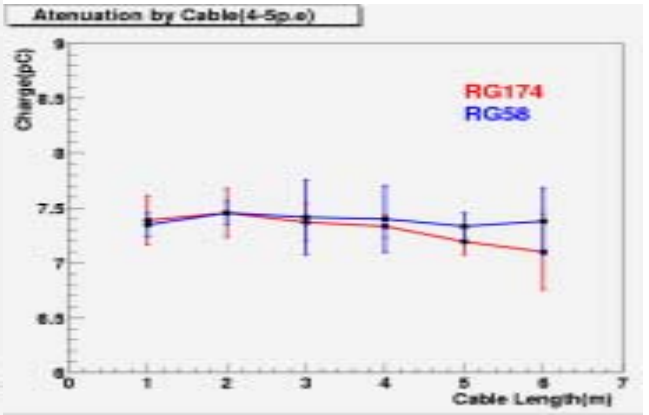
Here are some test pulse picture from pulse generator.
Lower Graph is difference of integrated charge from RG174 and RG58.
At the Aerogel counter, length of signal cable is from 1.5m to 3.5m.
In this length, RG174 is not so much different from RG58.

RG174 is enough cable.









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Cable from Preamp to FEE UL2833

The UL2833 Cable is used between preamp and FEE.

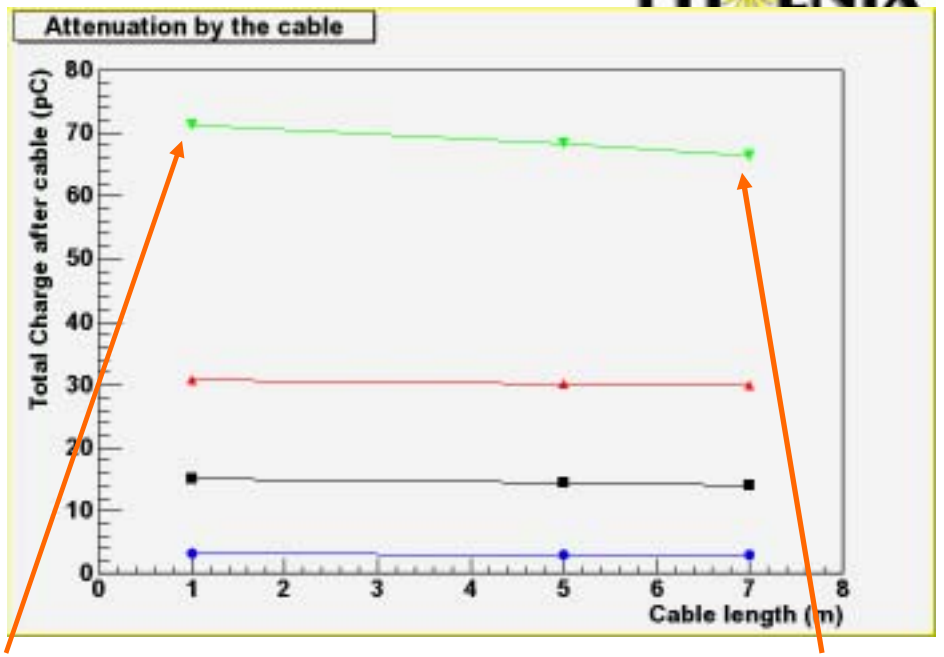
Fireproof: pass UL VW-1 test

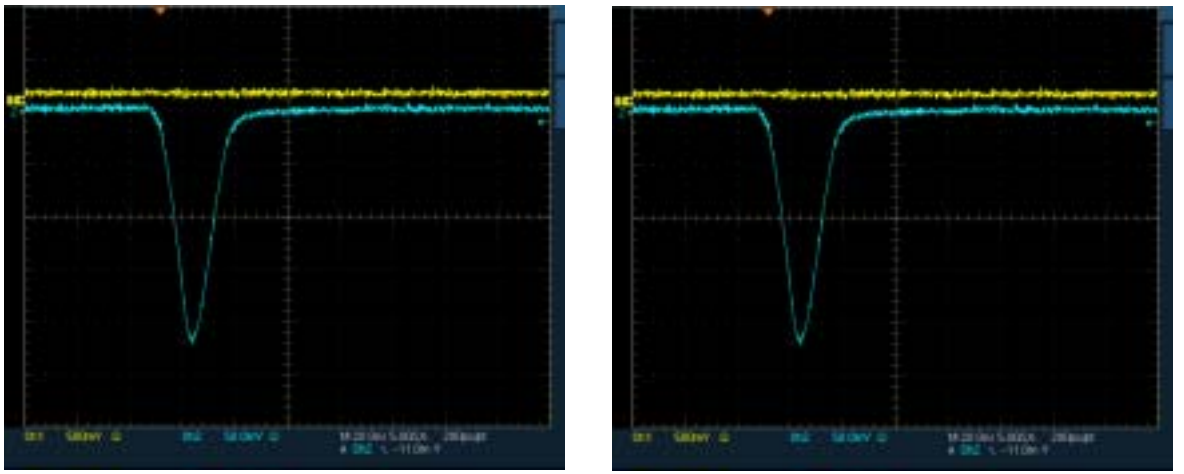
Figure is plots of charges after the cable.

Characteristics of Input pulses

- 200mV ~72pC (21 p.e.)
- 100mV ~30pC (9 p.e.)
- 50mV ~14pC (4 p.e.)
- 10mV ~2pC (0.6 p.e.)

There is a little attenuation, but it's not a problem.



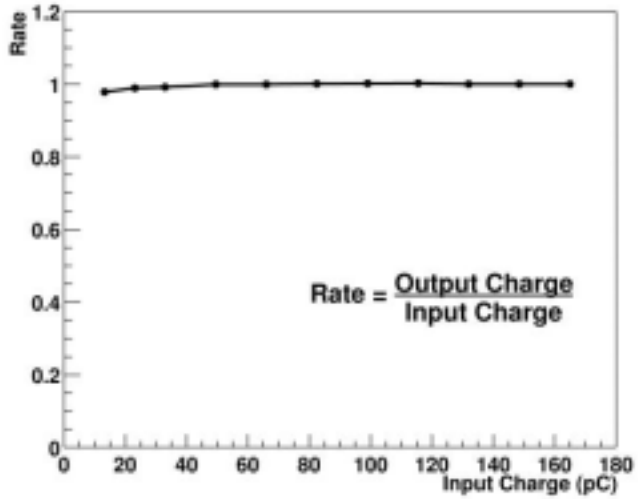


200mV pulse

Cable from Preamp to FEE

Total charge absorption is measured after UL2833 cable.

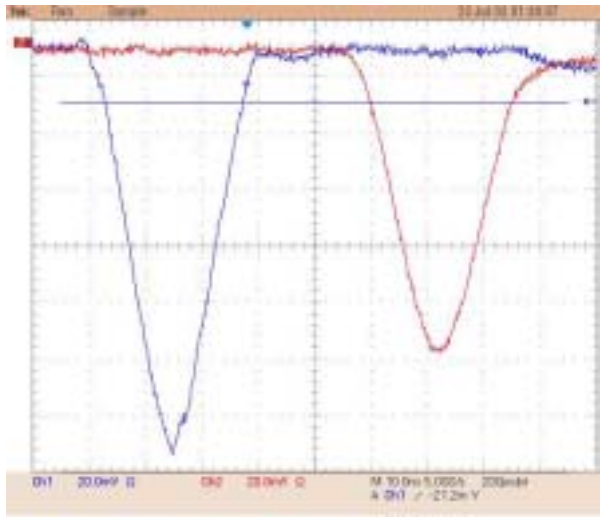
- The test is done using 5m cable, because we assumed the real cable length is 4m.
- Actual length is 7m. The difference between 5m and 7m is less than 1% .



The ratio of output charge over input charge

Pulse shape after the cable is measured.

- This measurement is done with 7m cable.
- The pulse height become 70 % of the input pulse height.
- It is still enough higher than TAC threshold.



Pulse shape of input and output after the cable

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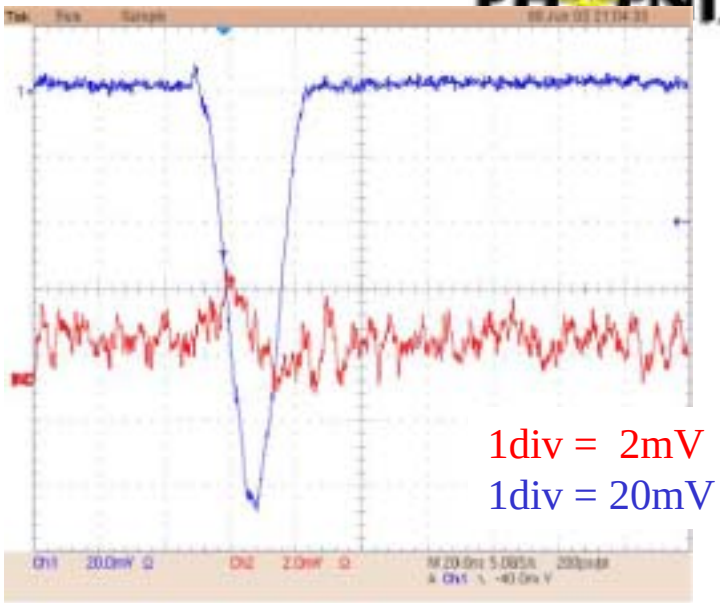
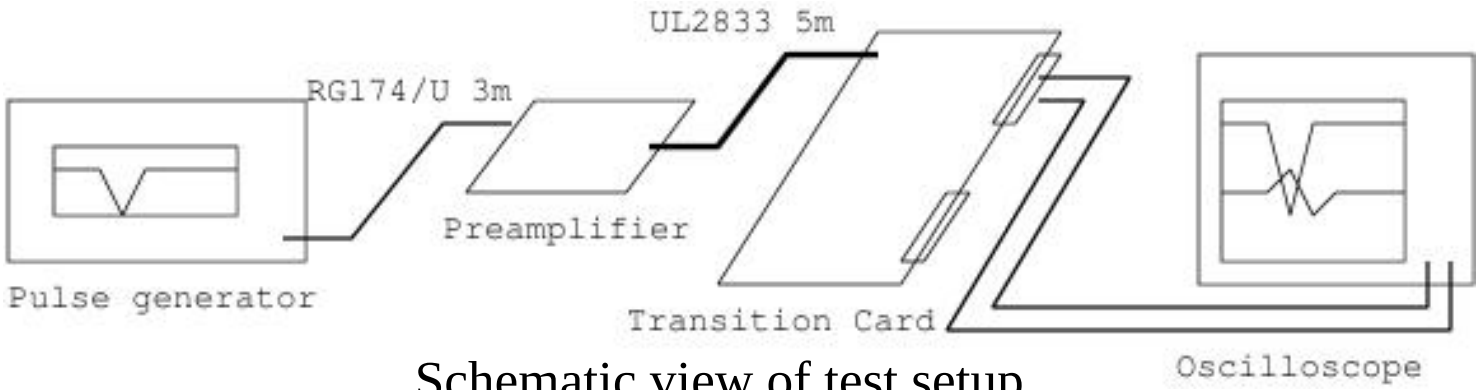
Cross talks

•The cross talks through all cables and boards were measured using the setup below.

•The next signal line is affected mostly.
•Each signal of cross talk is **bipolar signal.**
•Maximum pulse height of cross talk is **3%.**
  • For the 10 p.e. signals (130mv), the cross talk is 2 mV. (See the figure)
•From ADC measurement, the cross talk signal carry no charge.
•The trigger threshold will be 1 p.e. (10 mV). It is enough higher than cross talk pulse.



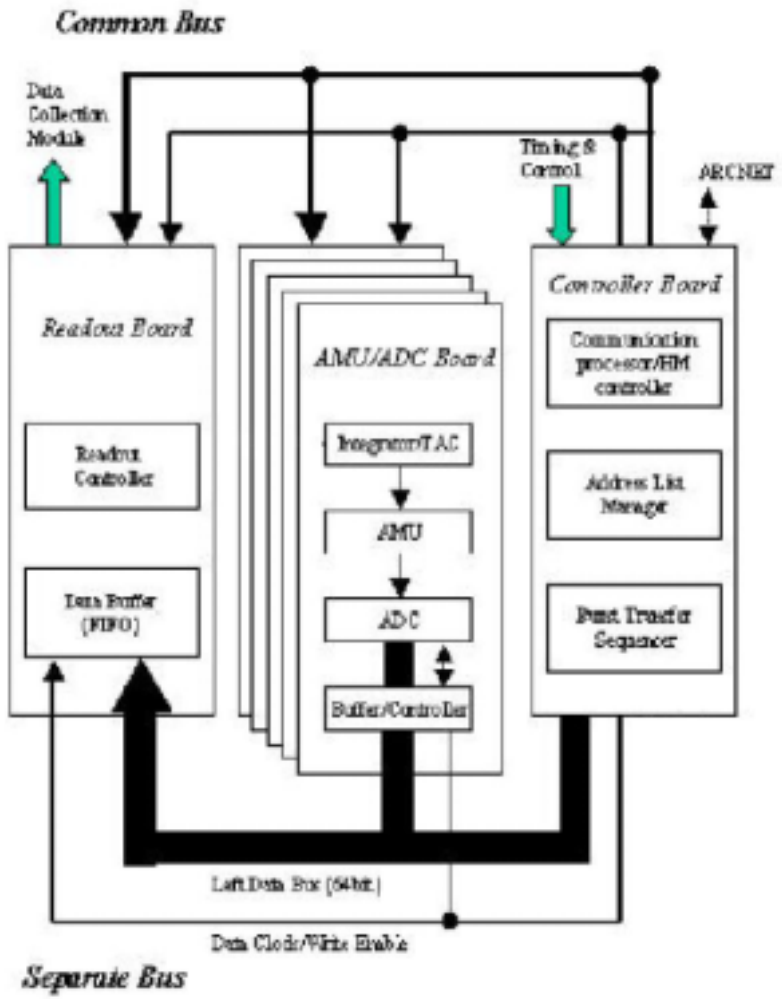
Shape of signal (10 pe) and cross talk



Schematic view of test setup

Front End Electronics

- Front End Electronics is the same as the RICH one, except for the trigger module.
- AMU/ADC module
  - 64 channels of 12-bits Analog to Digital Converter
  - Charge and Timing information is digitized on this module.
- Readout module
  - Collects data from AMU/ADC modules via a 32 bit bus on the back plane.
  - Send data to the Data Collection Module via G-Link fiber.
- Controller module
  - Performs all functions.
  - Provides timing, which comes from Master Timing Module



Block diagram of Aerogel FEE

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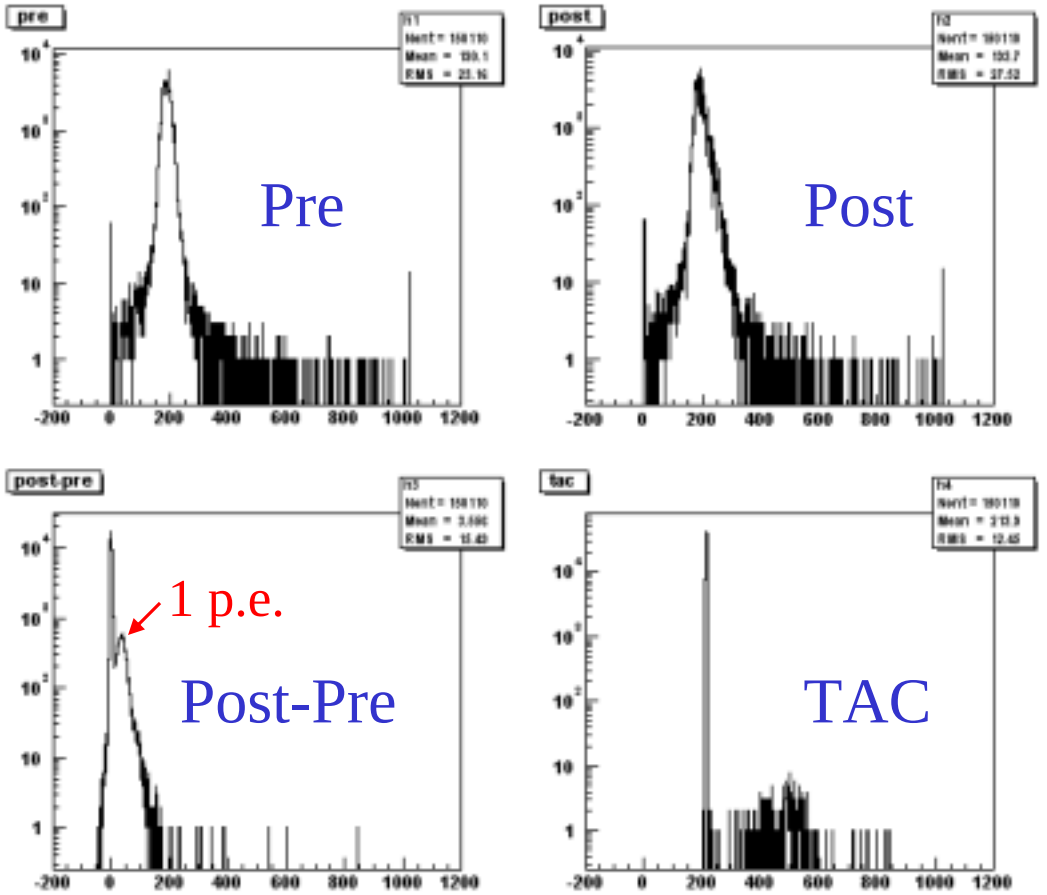
Total test

•Finally, we performed total test using all modules and boards.

- PMT signal is generated by LED light.
- •All real cables and module are used
- •The histograms are took by the Aerogel FEE.

•We can clearly see the 1 p.e. peak.



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LVL-1 trigger plan

In trigger module

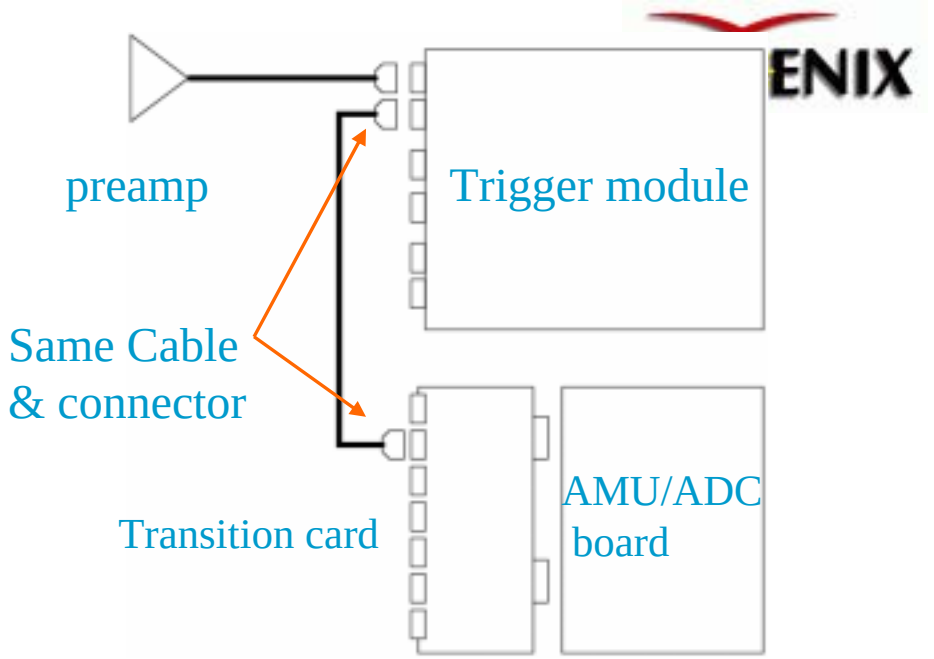
- Signal is received by the buffer amp and split two signals, one to trigger circuit and other to FEE.
- Coincidence logic is applied.
- One trigger tile should contains 4 segments to match the ERT tile.
- Trigger signal will be send to the RICH trigger ROC boards. This boards have un-used 64 channels in one arm.
- (40 channels are needed.)

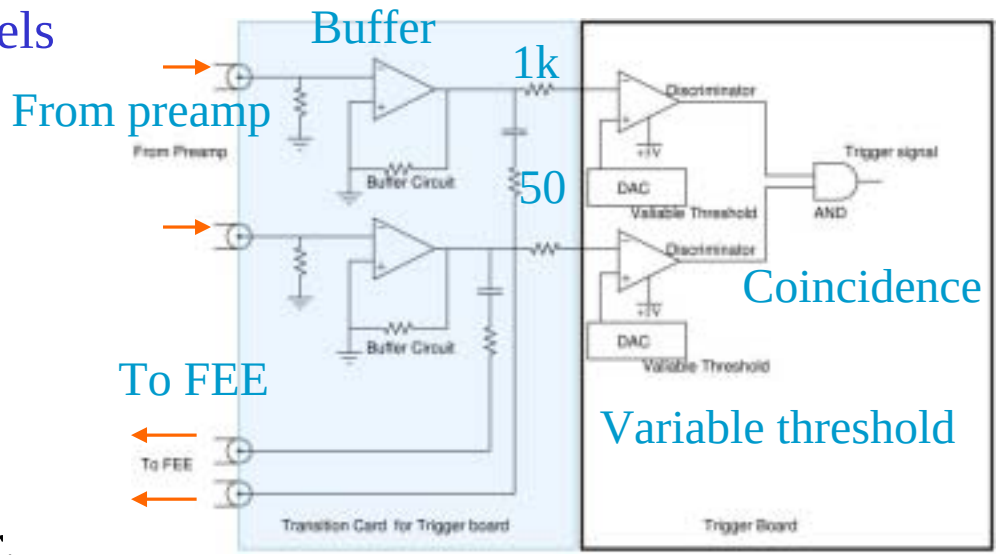
This is just a plan.

- We will make another CDR before install.

Concern is pulse shape.

- We are discussing about integrator before discriminator.





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LVL-2 trigger (by Hiroshi Masui)

For the measurements of identified high pT hadrons in A-A collisions, LVL-2 trigger is very useful.

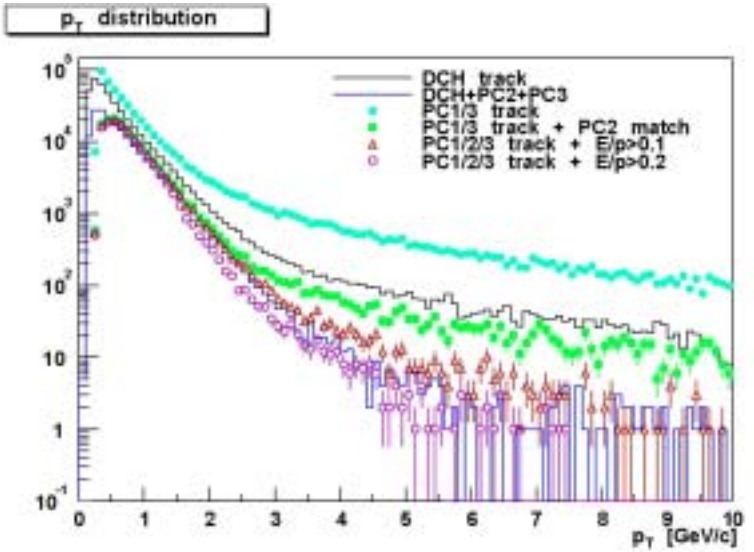
Trigger design

- Select PC1/PC2/PC3 track in the Aerogel acceptance
- Cut on the momentum of PC tracks
  - PC1/3 track has the 5% momentum res.
- Apply energy and momentum matching
  - Reduce the decays and conversions

Rejection factors with Run-2 data

Set the momentum threshold is 5.0 GeV/c,

4.3	PC1/3 track only
27.6	PC1/2/3 track
272.4	PC1/2/3 track and E/p > 0.1
1600.6	PC1/2/3 track and E/p > 0.2



pT distribution